Within this group of subfertile men, a scrotal varicocele has been identified as a well-established cause of decreased testicular function. It is also the most common surgically correctable cause of subfertility in men. While present in about 15% of the normal male population, the incidence is much higher (30% to 40%) in subfertile men, and surgical correction is associated with improvement in fertility in a large number of such patients.

Anatomically, a varicocele is caused by unimpeded retrograde venous flow in the internal spermatic vein, with subsequent dilatation of the pampiniform plexus. It is frequently associated with incompetence of the venous valves of the spermatic vein. It occurs on the left side in about 85% of cases and is occasionally bilateral, but rarely right-sided only.

The specific cause of abnormal testicular function in association with a varicocele is not established. It is most often felt to reflect a disturbance in the temperature regulation and an increase in scrotal temperature, but it may be due to retrograde flow of adrenal metabolites and renal hormones through the renal vein into the spermatic vein, affecting spermatogenesis. Collateral circulation connecting the venous system of the right and left testes would account for a bilateral effect from a unilateral abnormality.

A varicocele is frequently diagnosed by manual examination alone, based on palpability of the dilated pampiniform plexus (frequently during a Valsalva's maneuver), possibly in association with a decrease in the size of the ipsilateral testis. Physical examination, however, is not specific or highly sensitive. Semen analysis may show nonspecific abnormalities, including a "stress pattern," with abnormal sperm forms and decreased motility. The Doppler stethoscope and ultrasonography may assist in making the diagnosis but are likewise nonspecific. Venography is frequently diagnostic, but is invasive and often difficult to do.

The radionuclide demonstration of a varix is accomplished by labeling a patient's erythrocytes with technetium Tc 99m pertechnetate, the same agent used in routine cardiac imaging (gated cineangiography). The patient's cells are labeled by an in vivo technique with two peripheral venous injections. A radionuclide perfusion study is done at the time of injection of the isotope to evaluate for evidence of certain disorders, particularly for hyperemia, which would indicate an inflammatory condition.

The scrotal "blood pool" is statically imaged within minutes after injection, with the imaging done anteriorly and with the use of median raphe markers and upright (standing) and Valsalva's maneuvers as provocative measures.

Because the testicles are relatively hypovascular organs, the diagnosis of a varicocele depends on showing increased blood pool activity surrounding the left testis relative to the right. Additionally, regions of interest are developed by computer over each hemiscrotum to quantitate scrotal vascularity. A difference (left versus right) of greater than 10% to 15% is considered significant. Quantitative analysis may be impractical in the approximately 15% of bilateral varices, however, and visual analysis occasionally difficult if symmetry is present.

In clinical experience, the radionuclide examination has better sensitivity when compared with clinical suspicion alone. It may also confirm suspected but unproved varix formation or the presence of bilateral varices. The test represents an improvement in the detection and diagnosis of varicocele formation and offers a noninvasive, risk-free and cost-effective approach to diagnosis in subfertile men.

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Preoperative Scintigraphic Location of Parathyroid Tumors

PARATHYROID SCINTIGRAPHY has recently been reevaluated after the appearance of reports from Italy on the use of technetium 99m and thallium 201 for locating parathyroid adenomas. Hyperparathyroidism is a common clinical problem and operative localization of such tumors is sometimes difficult, with 5% to 10% of operations failing to localize a parathyroid tumor. It would be desirable then to identify their location preoperatively if a simple, noninvasive technique were available.

The technique initially reported was modified such that 2 to 3 mCi of thallium 201 is first administered, followed by 5 to 10 mCi of technetium Tc 99m pertechnetate. The patient is imaged over the thyroid-parathyroid region and the data computer acquired. Color images are generated using a special computer-comparison technique. Both analog and computer-processed color images can be used for localization.

As previously reported, single parathyroid adenomas were successfully localized preoperatively in 88% of patients without a previous parathyroid operation and in 86% of those with adenomas not located at a previous surgical procedure. In all, 83% of glands with secondary hyperplasia, 66% with primary hyperplasia and one patient with carcinoma were detected. Both published analog methods and color-comparison dual-isotope scintigraphy exceed the reported sensitivities of either ultrasonography or computed tomography. Using the color-comparison method, 87% of ectopic parathyroid tumors are successfully localized and patients with forearm transplants can also be evaluated. Modest goiters do not interfere and normal or suppressed parathyroid glands are not seen.

The benefits of dual-isotope localization techniques include the following: aid in differentiating preoperatively between hyperplasia and adenoma, shortened surgical time (and dissection), which ultimately lowers operative costs, and ability to evaluate cases in which a previous operation has failed to locate the parathyroid abnormality. Published studies strongly support the use of preoperative localization of parathyroid tumors by nuclear scintigraphy.

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Ureteral Reflux and Residual Volumes—Minimizing Irradiation

VESICOURETERAL REFLUX IN CHILDHOOD has been clearly implicated as a cause of significant injury to the kidney. Reflux nephropathy is a complex issue and concerns both renal infection and direct renal injury caused by penetration of urine into the renal pyramid. Traditionally, children presenting with a urinary tract infection have been evaluated by intravenous urography and contrast cystography. Present methods of evaluation in many centers consist of an ultrasonogram of the kidneys with a radionuclide cystogram in female patients but a conventional contrast cystourethrogram in male patients. In either sex, cystography is done at about seven to ten days following antibiotic therapy, as it is likely that during the acute phase of an infectious process there may be sufficient bladder wall edema to prevent detection of clinically significant reflux.

Regardless of the method of initial evaluation, the radionuclide cystogram is the method of choice for sequential evaluation. The technique has been well described and it is simple to do. A small feeding catheter is aseptically inserted into the urinary bladder via the urethra. About 100 ml of sterile 0.1 normal saline is instilled into the bladder. A 250-μCi dose of technetium Tc 99m sulfur colloid is administered via intravenous tubing. The patient's bladder is then slowly filled to the point of spontaneous voiding. Continuous posterior renal scintiphotos and computer data that include the dome of the urinary bladder are obtained sequentially. A technique for indirect radionuclide cystography has been described; although it may be more physiologic, most observers feel that there is a substantial risk of missing clinically significant reflux using this method.

Following voiding, the residual urinary tract volume may be calculated. This is a simple measurement based on prevoiding and postvoiding urinary tract counts and the volume of urine voided. The amount of residual bladder volume has much less consequence than that retained in the entire collecting system, which should be determined when one calculates these values.

Although difficult to document, many observers feel that the radionuclide cystogram is more sensitive for detecting clinically significant reflux than the conventional contrast cystogram. This relates to the continuous monitoring and the greater ease of detection of small amounts of complete (to the level of the renal pelvis) reflux. The single most consequential aspect of the difference between radiographic contrast and radionuclide cystography is the radiation dose. A typical 30-minute radionuclide cystogram delivers about 30 mrads to the bladder wall, less than 5 mrads to the male gonads and about 2 to 3 mrads to the ovaries. These figures represent about 1/100th of the radiation-delivered dose from a well-done radiographic contrast cystogram.

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Bone Scintigraphy—No Diagnostic Equal

DESPITE MAJOR ADVANCES in computed tomography and nuclear magnetic resonance, bone scintigraphy remains the most sensitive and the most practical whole-body screening procedure for skeletal involvement with malignancy. For proper cost-effectiveness, however, bone scanning should be used routinely only to evaluate those malignant disorders with a substantial likelihood of skeletal dissemination. With the probability of bone scan positivity at diagnosis indicated in parentheses, these tumors include stages III and IV rhabdomyosarcoma (56%), neuroblastoma (51%), prostatic carcinoma (31.8%), Hodgkin's disease (27%), stage III breast carcinoma (22.5%) and all other lymphomas (14%). Cancers not warranting routine bone scintigraphy at diagnosis include bladder carcinoma (5% to 15%), cervical carcinoma (0% to 10%), asymptomatic bronchogenic carcinoma (6% to 8%), ovarian carcinoma (0% to 8%), uterine carcinoma (0% to 4%), head and neck cancer (1%) and stages I and II malignant melanoma (0% to 1%). In stages I and II breast carcinoma (2% to 6%), annual bone scans are appropriate to follow the disease because of the high probability of skeletal involvement at recurrence (7% to 58%).

Although 37% of bone scans are positive at diagnosis in patients with multiple myeloma, skeletal radiography is clearly superior in sensitivity. In all patients with malignancy, bone scintigraphy is appropriate to evaluate musculoskeletal pain or an elevated serum alkaline phosphatase level. In primary bone cancer, the bone scan can effectively show the extent of the primary lesion, spread to distal skeletal sites (11% to 45%) and calcified soft tissue metastases.

Among benign skeletal processes, the bone scan is useful to evaluate symptomatic osteoid osteoma (including surgical location), fibrous dysplasia, brown tumors and aneurysmal bone cysts. Its high sensitivity for acute osteomyelitis in adults (90% to 95%) can be equaled in children by the use of the three-phase bone scan. Combined with gallium 67 or indium 111-granulocyte scintigraphy, it is effective in assessing chronic osteomyelitis and in differentiating loosening from infection in joint prostheses. Subradiographic fractures, especially stress fractures, are best identified by bone scintigraphy. Paget's disease produces intensely positive labeling on a bone scan, so that bone scintigraphy is useful in evaluating the extent of pagetic skeletal involvement, including monostotic versus polyostotic Paget's disease and, to a lesser extent, in monitoring response to therapy or progression of disease. Temporomandibular joint disease is detected with 94% sensitivity by single photon emission computed tomography. The evolution of avascular necrosis (and other types of bone infarction) is well delineated by serial bone scans. Although the bone scan is abnormal in a large variety of arthritic and degenerative joint conditions, making positive findings highly nonspecific, it can be useful in establishing the presence of early inflammatory joint involvement before radio-